



Effectiveness of algorithm based teaching on recognition and management of periarrest bradyarrhythmias among interns – a randomized control study

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ABSTRACT

Background & Objectives: Anesthesiologists deal with arrhythmias frequently both inside and outside operating room. Knowledge for recognition of arrhythmias is complex and difficult to impart to students despite various teaching methods suggested previously. The available methods though reported to be effective, are apparently complex and tested only on small groups. We designed an algorithm for recognition of bradyarrhythmias and assessed its effectiveness in recognition of correct rhythm among interns of our hospital.

Methodology: This randomised control study was conducted after approval from institutional research committee. Study group included seventy medical students of our university, undergoing compulsory rotatory internship at its constituent hospital and agreed to participate in the study. A teaching session on basic cardiac electrophysiology was conducted for both of the groups. This was followed by a pre-test 15 days later. Immediately after the pre-test, the participants were randomised into two groups and exposed to educational material on recognition and management of bradyarrhythmias based on algorithm approach in group A and power point presentation in group B. Assessment was conducted once immediately following the class and then on day 60. Ability to recognize correct rhythm and time taken to do so along with time taken to verbalize correct treatment was recorded.

Results: On day 0 there was no significant difference between the two groups with respect to number of participants who could recognize correct rhythm ($p = 0.314$). Mean time taken to recognize correct rhythm was also comparable between the two groups. On day 60, significantly greater number of participants in algorithm group could identify correct rhythm as compared to those in power point based group ($n = 22$ versus 10; $p = 0.007$). Time taken in both groups was comparable on day 0 as well as day 60. Time taken to verbalise correct treatment was also comparable in both groups on both occasions.

Conclusion: Algorithm-based approach is more effectively retained as compared to power point based teaching.

Key words: Bradyarrhythmias; Algorithm; ECG interpretation; Teaching tool; Retention skills

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INTRODUCTION

Electrocardiogram (ECG) is one of the most efficient point of care diagnostic tests for detecting life-threatening conditions, allowing a timely delivery of emergency care. However, the ability of a clinician to interpret this test correctly actually determines its practical usefulness. Inaccurate interpretations of ECGs may lead to inappropriate management decisions, adverse patient outcomes, unnecessary additional testing, and even preventable deaths.^{1,2} Although ECG interpretation has always been an important component of both undergraduate and postgraduate medical training, numerous studies demonstrate alarming rates of inaccuracy and variability in interpreting ECGs among trainees.^{3,4} This could be because teaching ECG interpretation is not given much importance in undergraduate medical curriculum and there is no uniform format defined.

Various instructional mediums have been suggested to teach ECG interpretation competencies, including lectures, puzzles, web-based programs and online media.⁵⁻⁷ But the accuracy of these as sole methods for ECG interpretation remains unclear. Algorithm based approaches have been defined earlier with good efficacy in interpreting correct rhythms. They combine both bradyarrhythmias and tachyarrhythmias in a single algorithm making it apparently difficult to remember and recollect the effectiveness of these being tested on a relatively small student population.⁸

One of the important clinical situations where quick interpretation and decision making by anesthesiologist improves patient outcome is peri-arrest arrhythmias. We chose to first formulate an algorithm for bradyarrhythmias and assess its effectiveness, followed by similar algorithms for other ECG patterns. Moreover in our opinion, bradyarrhythmias are difficult to understand and need better analysis for correct recognition as compared to tachyarrhythmias, which can be more easily recognized based on the pattern of rhythm, which registers in the brain over repeated visualization.

We chose to conduct our study on interns as it is a larger group and in most teaching hospitals of India, interns are involved in direct patient care and may play a vital role in early recognition of such critical events alerting the rapid response team. Hence we chose medical interns undergoing compulsory rotatory internship in our hospital to check if algorithm based teaching of bradyarrhythmias is effective as compared to tradition teaching of arrhythmias through power point presentation.

METHODOLOGY

Institutional ethical committee approval was obtained to conduct this randomised control study. Study group included seventy medical students of our university, who were undergoing compulsory rotatory internship at its constituent hospital and agreed to participate in the study. A written informed consent was obtained. Students not willing to participate were excluded from the study. All participants were exposed to a lecture on basic cardiac electrophysiology and basics of electrocardiogram to ensure same level of basic knowledge in both the groups.

After an interval of 15 days, a pre-test was conducted to check comparability of both the groups on basic knowledge of ECG and recognition of arrhythmias. On the same day, class was conducted after dividing the participants into two study groups by computer generated randomization table. Following this, each group was exposed to the educational material based on the teaching methodology assigned to their group. One separate instructor was allotted for each of the groups to educate participants on the diagnosis and management of bradyarrhythmias (sinus bradycardia, first degree heart block, type one second degree heart block, and type II second degree heart block and third degree heart block) as per standard American heart association. Participants in Group A were educated using the algorithmic approach and were provided handouts of the algorithm (Figure 1 & 2). Group B were taught using a lecture with power point presentation and were also provided with handouts of the power point slides. Assessment of participants was done once immediately following the class (day 0) and once after a period of 60 days (day 60). During the assessment, each candidate was shown a rhythm containing one of the bradyarrhythmias. Parameters noted were; the ability of the participants to diagnose correct rhythm, time taken to diagnose correct rhythm, ability to verbalise its correct treatment and the time taken verbalise correct treatment.

Statistical analysis: All data were recorded on an excel sheet and analysed using SPSS statistical software version 17. Chi square test was applied to compare gender, pre-test scores and number of participants identifying correct rhythm in both groups. Unpaired T test was used to compare mean time taken to identify correct rhythm and verbalise correct treatment in both groups and paired t test to compare mean time taken within the same group on day 0 and day 60.

Sample size was calculated based on our pilot study conducted on 20 anesthesiology post graduates,

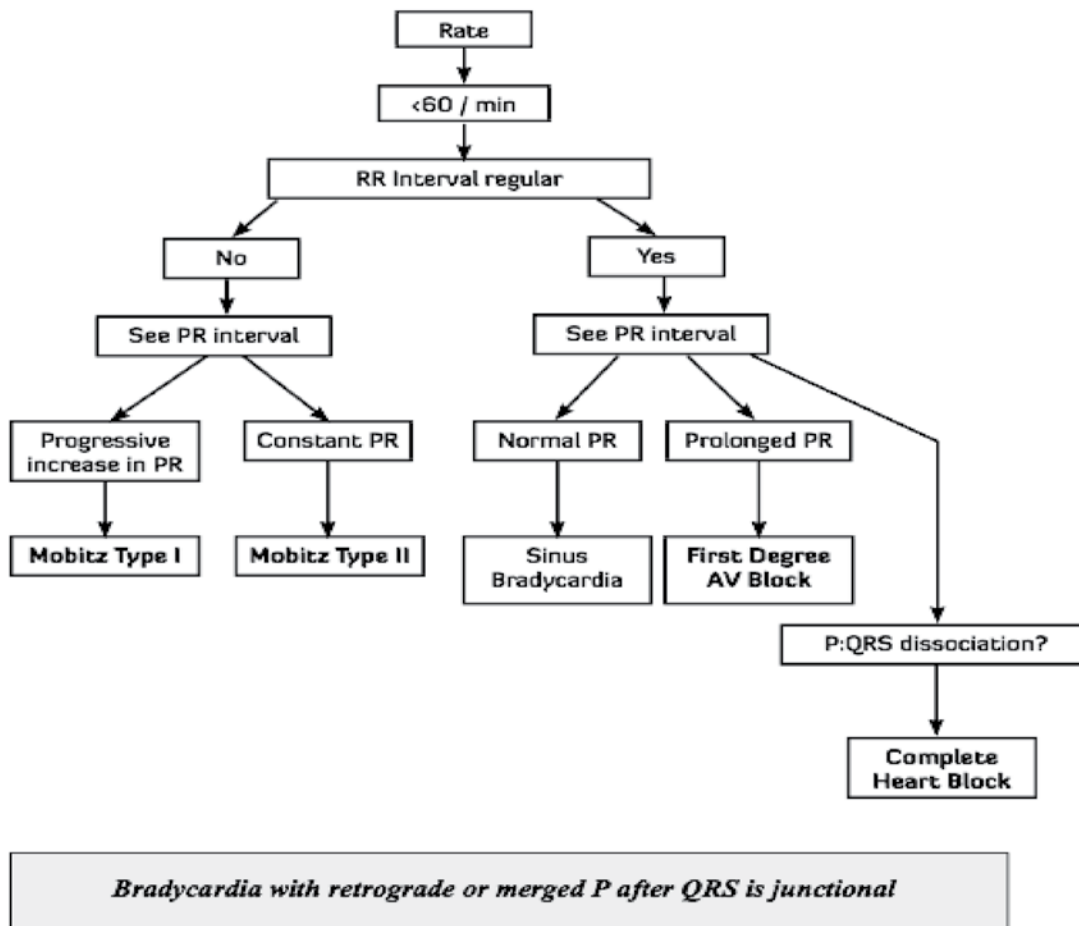


Figure 1: Algorithm for identification of bradyarrhythmias

Responsive patients (AB VOMIT)

1. **Airway** - Ensure it is patent
2. **Breathing** - Ensure rate & pattern is normal
3. **Vitals**
4. **O₂**
5. **Monitor** - See rate & rhythm
6. **IV Access**
7. **Treat as below** after considering heart rate, ECG rhythm & blood pressure.

	Systolic BP > 90 mmHg	Systolic BP < 90 mmHg
Heart Rate < 50/min	Observe and monitor	Atropine 0.5 mg iv, every 3-5 minutes, maximum 3 mg (cumulative) ↓ (If no response) Transcutaneous Pacing) ↓ (If not available or not effective) Dopamine infusion 2-10 mcg/kg/min (or) Epinephrine infusion 2-10 mcg/min

Figure 2: Algorithm for treatment of bradyarrhythmias

awareness, knowledge and attitude about labor analgesia

through which it was found that 40% of the students could correctly interpret bradyarrhythmias correctly after lecture based teaching and 75% could do that after algorithm based teaching. Considering these results with an alpha value of 0.05 and power of 80%, the sample size was calculated to be 31 in each group. Considering the dropouts we decided upon a sample size of 35 in each group.

RESULTS

All students who participated in the study completed pre-test and assessment immediately post class as well as at 60 days.

The two groups were not found to be statistically significant different with respect to gender distribution (0.092) (Figure III) or pre-test scores ($p = 0.871$) (Table 1).

Immediately after the class, 25 participants in Group A and 21 participants in Group B could identify correct rhythm respectively. The difference was found to be statistically insignificant ($p = 0.314$). Mean time taken to identify correct rhythm in both groups was not statistically significant ($p = 0.178$). (Table 2) 33 participants in Group A and 26 participants in Group B could verbalize correct treatment. This difference was significant statistically ($p = 0.022$). Mean time taken to verbalize correct treatment in Group A was

not significant statistically ($p = 0.700$) as compared to Group B (Table 2).

At day 60, correct rhythm was identified by 22 participants in group A and 10 participants in group B. This was found to be a statistically significant difference ($p = 0.004$). Mean time taken to identify correct rhythm was found to be statistically insignificant ($p = 0.525$). Mean time taken to verbalise correct treatment was also statistically insignificant ($p=0.173$). (Table 2).

To compare retention skills within both the groups, Time taken to identify correct rhythm on day of class was compared to that on day 60. It was found that participants in Group A took significantly more time on day 60 to identify correct rhythm as compared to the day of class ($p = 0.000$). Similarly, in Group B, participants took significantly more time on day 60 to identify correct rhythm as compared to the day of class ($p = 0.007$) (Table 3).

DISCUSSION

Training in interpretation of arrhythmias is complex and has the inherent difficulties of teaching large numbers of students on rare and serious clinical events in a vulnerable patient population.⁹ This study was undertaken to identify if algorithm based approach can be effectively used to train medical interns in interpretation and deciding line of management for bradyarrhythmias.

We found that on the day of class (day 0), the time taken to identify correct rhythm was 4 seconds faster in Group A as compared to Group B but this difference is insignificant statistically as well as in real time clinical scenarios. Time taken to verbalize correct treatment was similar in both the groups. (Table 2) This could be because the assessment was done immediately following the class and participants in both the groups could readily recall the information provided and apply it. There are no previous studies available to assess mean time taken to interpret the rhythm correctly.

On analysis of retention

Table 1: Comparison of pre-test scores in the two groups.

Pre-test score	Group A	Group B
Mean \pm SD	4.69 \pm 1.40	4.46 \pm 1.59
Minimum	2	2
Maximum	8	9

Table 2: comparison of mean time to identify correct rhythm and verbalise correct treatment

Variables	Group A (Mean \pm SD)	Group B (Mean \pm SD)	p value
Time (sec) to identify Correct rhythm on day 0	21.44 \pm 11.66	17.33 \pm 12.57	0.178
Time (sec) to identify Correct rhythm on day 60	27.18 \pm 13.68	30.60 \pm 13.87	0.525
Time (sec) to verbalise Correct treatment on day 0	8.73 \pm 6.52	8.42 \pm 7.36	0.700
Time (sec) to verbalise Correct treatment on day 60	13.32 \pm 8.029	10.64 \pm 7.27	0.172

Table 3: Comparison of retention of knowledge in the two groups

Groups	Time (sec) to identify correct rhythm on day 0	Time (sec) to identify correct rhythm on day 60	p value
Group A	21.44 \pm 11.66	27.18 \pm 13.68	0.000
Group B	17.33 \pm 12.57	30.60 \pm 13.87	0.007

skills in both the groups on day 60 it was found that number of participants who could correctly recognize the given rhythm in Group A was significantly more (n=22) as compared to Group B (n =10) (p= 0.000). We assume this could be because in Group A participants could recollect the critical analysis of the rhythm in stepwise manner and rule out possibilities at each step coming to a correct diagnosis more frequently as compared to those in Group B who had to depend on their memory for completely recollecting the information on diagnosis of a bradyarrhythmia. A stepwise approach might be easier to retain and apply at a future instance.

Although the mean time taken to verbalize correct rhythm between the two groups was comparable (Table 2); within the same group all participants had taken significantly more time on day 60 as compared to day 0 (Table 3). While in Group A, participants took 7 seconds more to identify correct rhythm on day 60 as compared to day 0, in Group B the time taken increased by 13 seconds; however, it is not clinically relevant in either case. (Table 3) This may be because of fading of information provided which occurred in absence of intermittent revision during the 60-day period requiring more time to recollect the learned information. Previous research has shown that spaced education can improve retention of clinical knowledge in medical students.¹⁰ Simulation based training of medical knowledge and skills also claim higher retention skills.^{11,12} But It has limitations which include lack of infrastructure, exorbitant cost and need for trained / skilled instructors.¹³ Algorithm based teaching is a potentially effective tool to enhance skills of anesthesia post graduates and junior doctors

on recognition and management of life-threatening situations thus improving patient outcome.

We recommend frequent revisions of this algorithm for better retention of knowledge and faster recognition of bradyarrhythmias. Future studies may be designed to assess the effect of spaced repetition on retention of knowledge in recognition and management of arrhythmias using algorithm based approach.

CONCLUSION

Hence we conclude that the retention of knowledge for recognition of bradyarrhythmias was better in algorithm based approach in terms of number of participants correctly recognizing the rhythm after 60 days of class. Time taken to interpret correct rhythm and verbalise correct treatment was similar and clinically acceptable in both the groups. These results can be utilized for the development of algorithms to diagnose and manage tachyarrhythmias and other ECG rhythms.

Conflicting Interest: Nil

Authors' contribution:

KN, RP, VRHK – Concept, Design of study, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing & review

AM - Concept, Manuscript preparation, Manuscript editing

DRS - Concept, Design of study, Literature search, Data acquisition, Manuscript preparation, Manuscript editing

TS - Concept, Design of study, Manuscript preparation, Manuscript editing

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